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THE CONTRIBUTION OF NONDEPRIVATION FACTORS IN THE PRODUCTION OF SENSORY DEPRIVATION EFFECTS:

THE PSYCHOLOGY OF THE "PANIC BUTTON" [1]

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From the premise that both social cue factors, or demand characteristics, and sensory deprivation operations combine in producing commonly observed effects of sensory deprivation, an experiment is reported which tests the hypothesis that sensory deprivation effects can be produced by manipulating demand characteristics while holding the effect of the physical environment constant. Experimental Ss were exposed to pre-experimental conditions which were designed to imply to them that sensory deprivation effects were expected to emerge. The same physical conditions were structured for control Ss in such a way as to lead them to expect nothing to happen. Results show that the groups were significantly different on a number of before and after tests, as well as in general clinical appearance, and these results were interpreted as supporting the hypothesis. An interpretation is offered of the operation of demand characteristics as a factor interacting with treatment conditions. Ways of taking demand characteristics into account in sensory deprivation research are suggested.

It seems reasonable to view the subject in a psychological experiment as a social as well as an experimental animal. To do so, however, makes necessary a distinction between that part of the subject's behavior which is a function of the experimental variable under analysis and that part which is tied to his perception of the experiment as a social situation.

To support this view, Orne (1959b) has shown that subjects in hypnosis experiments behave in a way that is largely congruent with their preconceptions of hypnosis. Orne (1959a; 1962), in developing the concept of "demand characteristics," has also suggested that the results of many psychological experiments are liable to be biased by those cues, both implicit and explicit, that communicate to the subject what is expected of him in the experimental situation.

The results of any experiment involving human subjects are seen to include at least two distinct components. The first, which may be called the true experimental effect, is entirely contingent upon the antecedence of the independent variable. The second is induced by the social cues that attend the experimental situation and is unrelated to the independent variable. An analogy may aptly be drawn to the distinction between "real" and "placebo" effects in pharmacological research, where it is first necessary to discern the extent and direction of the placebo component before a meaningful conclusion can be drawn about the real effect.

Research findings on sensory deprivation are likely to be subject to the kind of bias here described. Little attempt has been made to separate those aspects of the reactions to sensory deprivation actually due to the diminution of sensory input from those due to the matrix of social cues surrounding the experimental situation.[3]

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[3] One notable exception is the work of Jackson (1960; Jackson & Kelly, 1962) who explored the role of "indirect suggestion" in the production of sensory deprivation effects.

Since the first studies at McGill University in 1951, there have been many attempts to delineate and account for the effects of prolonged sensory deprivation. Experimental techniques have been devised to reduce insofar as possible all forms of external stimulation. The McGill research employed a sound-damped cubicle: the subject rests on a soft bed, wearing translucent goggles over his eyes and cardboard gauntlets over his forearms and hands (Bexton, Heron, & Scott, 1954). Another technique involves placing normal subjects in tank-type respirators, so that movement is restricted and external sources of stimulation are rendered fairly homogeneous (Leiderman, Mendelson, Wexler, & Solomon, 1958). A third technique consists of prolonged total immersion in a tank of water at body temperature, with the subject using a face mask for breathing (Lilly, 1956). With a very few exceptions (Vernon & McGill, 1957; Zubek, Sansom, & Prysiazniuk, 1960) these procedures have produced significant changes in behavior, usually in the form of a decrement in psychological efficiency.

Bexton et al. (1954) report a general cognitive deterioration under the McGill conditions. Deprivation subjects showed decrements on a number of pre- and postisolation cognitive tasks. Subjects reported an intenseness of visual imagery, an inability to concentrate, and spatial and temporal disorientation. Scott, Bexton, Heron, and Doane (1959) and Doane, Mahatoo, Heron, and Scott (1959) provide further evidence on several more testing instruments, including some of the perceptual-motor variety. The findings of Vernon, McGill, Gulick, and Candland (1961) have been less striking, but the general tenor of their conclusions is the same. Likewise, studies by Zubek et al. (1960) and Zubek, Pushkar, Sansom, and Gowing (1961) show an impairment of mental functioning along the lines noted above. A remark by Hebb (1958) perhaps best epitomizes the findings of these studies: "Without physical pain, without drugs, the personality can be badly deformed simply by modifying the perceptual environment [p. 110]."

An alternative view of these data would be that at least in part the dramatic effects could be a function of the demand characteristics of the experimental situation. Thus, the cues in the experimental procedure itself would communicate to the subject the behavior expected of him.

There is evidence in an experiment by Kandel, Myers, and Murphy (1958) that preparing a subject for probable hallucinations significantly affects the frequency of hallucinations. This preparation was accomplished by verbal instructions. However, such devices as "panic buttons" in experiments (Vernon et al., 1961; Zubek et al., 1961) are in a sense eloquent "instructions." The use of such a device increases the subject's expectation that something intolerable may occur, and, with it, the likelihood of a bad experience.

Indeed, it is possible to refer to many potential role cues of greater or lesser subtlety. In an experiment by Freedman, Grunebaum, and Greenblatt (1961), subjects were required to sign a forbidding release form prior to participation. Psychiatric screenings have been commonly used to single out individuals who might be harmed by an experiment, and physical examinations have been given to make sure of the subject's ability to withstand experimental stress. Even the existence of such experimental accouterments as observation windows and microphones have a potential cue value. As one of our own subjects remarked, "If you didn't expect to see or hear something unusual, why were you looking and listening?"

It should be made clear that the experiment to be described was *not* designed to test any hypothesis about the *nature* of sensory deprivation. Rather it was aimed at calling attention to a set of variables which must be considered in evaluating that phenomenon. The postulate that certain cues increase the likelihood of occurrence of a predicted effect is easily converted into an empirical question: If the cues attending the typical sensory deprivation experiment are retained *while no sensory deprivation takes place,* is it still possible to produce effects similar to those produced in such an experiment?

METHOD

Subjects

Subjects were recruited for "a psychological experiment in Meaning Deprivation" through the placement services of colleges and universities in the Boston area. Each subject was paid $2 an hour plus transportation costs. In order to correspond more closely with the practice in most previous sensory deprivation experiments, only male college students ranging in age from 18 to 25 were used. Subjects were excluded who had previously participated in sensory deprivation experiments or who were too familiar with sensory deprivation experiment results.[4] Twenty subjects in all took part; each was assigned alternately to the experimental and control groups, with 10 subjects comprising each group.

Procedure for Experimental Group

All subjects who called to volunteer were told that the experimental session would last an indefinite period of time, and that in order for the subject to participate, it would be necessary for him to reserve an entire day or entire evening. He was also told that the experiment was to be performed at a psychiatric hospital.

When the subject arrived there he was greeted by the experimenter, dressed in a white medical coat. Prior to giving instructions, the experimenter asked the subject briefly about his medical history, asked him whether he had a history of dizziness, or fainting spells, and so on. An aura of great seriousness and importance was maintained throughout this introductory period. As a prop to reinforce the subject's notion that great caution was necessary in the experiment, a tray of drugs and medical instruments, labeled "Emergency Tray" was in full view. No direct reference was ever made to this tray unless the subject asked, and then he was told that this was one of the precautionary measures taken for the experiment, and that he had nothing to worry about.

At the conclusion of the introductory remarks, the following set of instructions, a composite of the instructions used in other sensory deprivation experiments, was read to the subject:

> The experiment for which you have volunteered has as its object the determination of the psychological consequences of a special kind of deprivation procedure.
>
> There are three parts to the experiment: Testing Period I, the Experimental Deprivation Condition, and Testing Period II. You will receive special instructions in the testing periods.
>
> During the deprivation period, which will last an undisclosed length of time, you will have an optional task involving adding numbers, the full instructions for which will be explained once we enter the chamber.
>
> While you are in the chamber, you will be under constant observation. Also, there will be a microphone through which anything you might say will be recorded. It is important that you report your experiences freely and completely. You are not expected to talk a great deal, but you should report any visual imagery, fantasies, special or unusual feelings, difficulties in concentration, hallucinations, feelings of disorientation, or the like. Such experiences are not unusual under the conditions to which you are to be subjected.
>
> If at any time you feel very discomforted, you may obtain release immediately by pressing the button which I will show you once we enter the chamber ["by knocking on the window," for control subjects]. Do not hesitate to use this button if the situation becomes difficult [this sentence deleted for control subjects]. However, try to stick it out if you can.
>
> Should you feel upset, or should anything untoward develop, a physician is immediately at hand [this sentence deleted for control subjects].
>
> Remember, I should like you to pay special attention to any special visual or other sensations, or feelings of disorientation, and to report these experiences as they happen.
>
> Do you have any questions?

At the conclusion of the instructions, questions were answered if at all possible by referring to portions of the written instructions. The subject was then asked to sign a release form that was almost identical in detail with the one used by Freedman et al. (1961). It was worded so as to relieve the Massachusetts Mental Health Center and all affiliated organizations and personnel from legal responsibility for consequences of the experiment. All experimental subjects signed the form, although some were a little reluctant to do so.

Next, the subjects' blood pressure and pulse count were recorded. These measures were also taken for control subjects, who were told, however, that it was being done only because it was part of the procedure for experimental subjects. After this, subjects were given the pretest battery to be described below. At the conclusion of the battery they were allowed to go to the bathroom, after which they were accompanied by the experimenter to the "isolation chamber."

The isolation chamber was a quiet room $6 \times 7 \times 8$ feet in dimension. It was furnished simply with a large oak desk and two comfortable chairs. Beige drapes covered a small, shaded window above the desk, but the room was amply lighted by a circular fluorescent fixture. One wall was fitted with a 2×4 foot observation window, the function of which was explained to the subject upon entering.

On the desk were a number of objects: a thermos of ice water, a glass, and a sandwich; a microphone; a stack of approximately 2,000 sheets of paper con-

[4] Four subjects were thus eliminated. One further subject was dropped because he was not only unable to perform two of the pretests—one involving a reversible figure and the other a mirror tracing task—but had great difficulty even in understanding the instructions.

taining numbers; a red pushbutton mounted on a board and labeled "Emergency Alarm."

In the instruction period the subject was informed that the food and water were for his convenience, and that he could partake of them at any time. He was told further that the microphone was sensitive enough to pick up anything said in the room, and that he should comment upon the experience whenever he felt so inclined.

Each sheet of paper containing numbers was made up of eight columns of single random digits. The subject was told that, as an optional task, he could add the adjacent digits in the columns, and record the sum in the space between them. It was made clear to him that he might do as much or as little of this task as he pleased, and that he did not have to do it at all if he did not want to. He was instructed, however, to confine his use of paper and pencil to the prescribed optional activity. In addition, he was requested to remain awake throughout the period, but was assured that if he really became sleepy, it was permissible to go to sleep.

The subject was finally informed that by pressing the pushbutton, which was shown to activate a loud alarm, he would obtain release from the experiment.

Upon completing the instructions, the experimenter asked the subject if everything was clear to him; if it was, the experimenter left, audibly locking the door behind him.

The room, it should be pointed out, could hardly be construed as a sensory deprivation environment. Voices and footsteps could be heard from other parts of the building, and at various times the sounds of automobiles, airplanes, and the chirping of birds outside were clearly audible. The room was well lighted and large enough for the subject to move about freely; movements were not prohibited by the instructions.

After the subject had been in the room for exactly 4 hours, the experimenter returned to carry out an interview of the type to be described below, and to run the subject again through the testing procedure: his blood pressure and pulse were rechecked; he was asked for further comments or questions at the conclusion, paid for his services, and released after he had promised not to relate details of the experiment to others. The entire procedure from the time the subject arrived to the time he left generally took 6 hours.

Procedure for Control Group

Control subjects were treated in exactly the same manner as experimental subjects except for the following particulars. First, when greeting the subject the experimenter wore business clothes and acted in a less officious manner. The testing room, or office, was not equipped with an emergency tray, nor was the medical history interview conducted. In lieu of this, the subject was told that he was part of a control group for a sensory deprivation experiment. The usual conditions of such an experiment—translucent goggles, white noise, arm gauntlets, soft bed, and restriction of activity—were described to the subject. He was informed that he would be given exactly the same tests and receive the same instructions, with minor modifications, that experimental sensory deprivation subjects received. He was told that it was necessary to place him in the same chamber for the same period of time, so that the effects of the more restrictive sensory deprivation conditions could be differentiated from the effects of simply being left alone in a room for a period of time. He was urged to report his experiences freely and completely, and was told that recordings were being made of all his comments. After these introductory remarks, the same set of instructions was read to the control subject as was read to the experimental meaning deprivation subject (with the modifications noted in the section on procedure for the experimental group).

The cubicle was outfitted in exactly the same way, except that there was no "Emergency Alarm." Control subjects were told that if they wanted to gain release they could do so by knocking on the window.

The postexperimental treatment was the same for both groups, except that the experimenter wore a white coat for the experimental subjects.

Tests and Criteria

Several criteria were used in the selection of tests. First, the choice was made from among the approximately 75 tests that have been used by previous investigators of sensory deprivation. Second, only those tests were considered which were reported as positive indicators of sensory deprivation; that is, the results of which were significantly different for control and experimental groups. From the 25 tests that met these criteria, 10 were selected on the basis of ease and speed of administration, ease and objectivity of scoring, and availability of testing materials. Tests of both cognitive and perceptual abilities were included. Whenever possible, exactly the same tests were used as were used by previous investigators. In some cases approximations were necessary because of a lack of adequate descriptions in the reports or the uniqueness of a test. The battery which emerged was as follows. Tests are listed in order of administration. Unless otherwise noted, tests were given in exactly the same way before and after isolation.

Mirror Tracing. Subjects were instructed to trace a line around the .25-inch border of a six pointed star on a conventional mirror drawing apparatus. The score was the number of times the traced line went out of the border. Vernon et al. (1961) found a significant decrement in the performance of this task after deprivation.

Spatial Orientation. Subjects were asked to draw a figure in response to specific commands, without seeing the paper on which they drew. For this purpose, a mirror drawing shield without the mirror was used. Instructions were as follows:

> Draw a line three inches to your left and stop. Now 90 degrees to the right of the direction you were moving, draw a line two inches and stop. Now 90 degrees to the right again, draw a line three inches and stop. Now 90 degrees to the left, draw a line three inches and stop. Now 90 degrees to the right, draw a line two inches and stop. Now 90 degrees to the right again, draw a line one inch and stop. Finally, draw a line back to your original starting position.

Figures were scored for both linear and angular deviation from the figure thus described. Doane et al. (1959) found experimental subjects exhibited significantly more angular deviation on this task, while linear deviation was apparently not scored. Linear deviation scores were included in the present experiment with the expectation that experimental subjects would also do worse on this aspect of spatial orientation.

Word Recognition. Subjects were given 90 seconds to study a list of 20 words that had been taken from words classified as AA (highest) frequency in the Thorndike-Lorge (1944) tabulation. Immediately at the conclusion of this period, subjects were instructed to circle, on a list of 70 words of similar frequency, as many of the original 20 as they recognized. After isolation, the recognition test was administered without additional opportunity for study. The score was the number of correct recognitions. This procedure was adapted from that of Zubek et al. (1960), who found significantly poorer recognition scores for experimental subjects.

Reversible Figure. Subjects were instructed to press a counter key every time there was a shift in a reversible figure. A 4×6 inch reproduction of the reversible staircase figure was used for this test. The score was the number of alterations in 1 minute. Significantly faster alternation cycles were found for experimental subjects by Freedman et al. (1961) and by Freedman and Greenblatt (1961).

The Digit-Symbol subtest of the Wechsler Adult Intelligence Scale. Standard administration and scoring procedures were used. Scott et al. (1959) and Davis, McCourt, and Solomon (1960) found a significant superiority in accuracy of control subjects in this task.

MacQuarrie-Morris Test of Mechanical Ability. Standard administration and scoring procedures were used. Zubek et al. (1960) and Vernon et al. (1961) found decrements for sensory deprivation subjects on motor coordination tasks very closely related to this test.

Simple Form perception. Six simple geometrical forms, completely regular, were cut from black construction paper and pasted on 10×10 inch neutral gray cards. These forms were: a plus sign, two parallel lines, a circle, a single straight line, an equilateral triangle, and a square. The cards were held one at a time in front of the viewer, at a distance of 12 feet. In the pretesting, subjects were asked to describe what they saw on the cards, and to note any irregularities. In the posttesting, the following instructions, identical to those used by Freedman and Greenblatt (1961), were given:

> I am going to show you some simple charts [cards], and I would like to have you tell me what each one looks like to you—not what you think it really is, but what it looks like subjectively.

Scores were obtained by subtracting the number of distortions reported in pretesting from the number reported in posttesting. No more than a single distortion was counted for each card. This test was given immediately after the subjects emerged from isolation, in congruence with the Freedman and Greenblatt procedure. These investigators found significantly more simple form distortions in experimental than in control subjects.

Size Constancy. Fifteen light gray circular disks of graduated diameter were pasted on a large sheet of dark gray cardboard and shown, from a distance of 12 feet, to the subjects who were asked to estimate which disk most approximated in size the standard disk, mounted on a similar background, and held 2 feet from the eyes. Scores were assigned in terms of the number and direction of step deviations from the standard. Doane et al. (1959) report that the subjects tend to see figures larger after deprivation. This test was pulled out of order and given right after the simple form perception test when the subject came out of the isolation chamber. This is in accord with the procedures of Doane et al. and also of Freedman and Greenblatt (1961).

Spiral Aftereffect. An 8-inch Archimedes spiral rotating at about 40 rpm was viewed at a distance of 3 feet for 90 seconds. At a signal from the experimenter, the subject shifted his vision to an identical spiral which was stationary. Subjects were instructed to say "stop" upon cessation of the movement aftereffect thus induced. The score was the number of seconds that the effect persisted. Doane et al. (1959) report a greater duration of this effect after isolation.

Logical Deductions. Subtest 3 of the Watson-Glazer Appraisal of Critical Thinking was administered after isolation only. Standard administration and scoring procedures were used. Goldberger and Holt (1958) found that the performance of sensory deprivation subjects on this test was significantly poorer than was that of controls.

The postisolation interview was conducted in exactly the same manner for all subjects. The experimenter first called upon the subject to express, at whatever length was agreeable to him, the general nature of his experience, his feelings, thoughts, and so forth. After these comments, the experimenter asked him to estimate the time he had spent in isolation and to make an affective evaluation of the experience; the experimenter questioned the subject on the presence of anxiety, of temporal or spatial disorientation, of distortions perception, or of perceptions of doubtful origin; finally the experimenter asked the subject to elaborate upon some of the

subject's opening remarks. The information gained in this interview, together with the notes made on visual observations of the subject and recording of his spontaneous remarks, was used in forming general clinical evaluations of his behavior in the experimental situation.

RESULTS

In Table 1 is presented summary information on the battery of 10 tests. The table includes determinations of statistical significance. Note the multiple methods of scoring for a few of the measures.

Although the pre-experimental performances of the experimental and control groups did not test significantly different, the analysis of covariance technique was used to take into account any systematic influence of initial values on the postexperimental comparisons. For comparisons without pre-experimental components, simple t tests were

TABLE 1

SUMMARY AND ANALYSIS OF 10 TESTS FOR CONTROL AND EXPERIMENTAL GROUPS

Test and group	Pretest *M*	Posttest *M*	Difference statistic
Mirror Tracing (errors)			
Experimental	28.1	19.7	$F = 1.67^a$
Control	35.8	15.2	
Spatial Orientation			
Angular deviation			
Experimental	45.7	53.9	$F = .25^a$
Control	52.5	59.1	
Linear deviation			
Experimental	5.3	5.4	$F = 3.34^*$
Control	6.4	5.7	
Word Recognition (*N* correct)			
Experimental	17.3	15.6	$t = .50$
Control	15.2	12.3	
Reversible Figure (rate per minute)			
Experimental	29.0	35.0	$F = 1.54^a$
Control	20.1	25.0	
Digit Symbol (*N* correct)			
Experimental	98.2	109.9	$F = .05^a$
Control	99.2	111.9	
Mechanical Ability			
Tapping speed (*N* completed)			
Experimental	33.9	32.2	$F = 2.26$
Control	32.9	35.0	
Tracing speed (*N* completed)			
Experimental	55.6	52.3	$F = 4.57^*$
Control	53.1	58.4	
Visual pursuit (*N* completed)			
Experimental	5.7	8.9	$F = .22^a$
Control	5.7	9.2	
Simple Forms (*N* increment distortions)			
Experimental	—	3.1	$U = 19^{**}$
Control	—	0.8	
Size Constancy (change in steps)			
Experimental	—	0.6	$t = 1.03^a$
Control	—	0.0	
Spiral Aftereffect			
Duration, seconds			
Experimental	24.4	27.1	$F = .99^a$
Control	15.6	16.1	
Absolute change			
Experimental	—	7.0	$t = 3.38^{***}$
Control	—	2.7	
Logical Deduction (*N* correct)			
Experimental	—	20.3	$t = 1.64$
Control	—	22.1	

Note.—F = adjusted postexperimental scores, analysis of covariance; t = t tests; U = Mann-Whitney U test, where plot of data appeared grossly abnormal.

[a] Indicates differences between groups were in predicted direction.

* $p < .05$, one-tailed.

** $p = .01$, one-tailed.

*** $p < .001$, nondirectional measure.

TABLE 2

OCCURRENCE OF SENSORY DEPRIVATION SYMPTOMS IN CONTROL AND EXPERIMENTAL SUBJECTS

Subject and group	Perceptual aberrations	Intellectual dullness	Affectively unpleasant	Anxiety fears	Spatial disorientation	Restlessness	Irritability	Total number of symptoms
Experimental								
E_1	X	X	0	0	X	0	0	3
E_2	X	0	X	X	X	X	X	6
E_3	X	X	X	0	0	X	0	4
E_4	0	X	X	X	X	X	0	5
E_5	X	X	X	X	X	X	X	7
E_6	X	X	X	X	0	X	X	6
E_7	0	X	0	0	0	0	0	1
E_8	0	0	0	0	0	0	X	1
E_9	X	X	X	X	X	X	X	7
E_{10}	X	X	0	X	X	X	X	6
Control								
C_1	0	0	0	0	0	0	0	0
C_2	X	0	0	X	0	0	0	2
C_3	0	0	0	0	0	0	0	0
C_4	0	0	0	0	0	0	0	0
C_5	X	0	X	X	X	X	0	5
C_6	0	0	0	0	0	0	0	0
C_7	X	0	0	X	0	0	X	3
C_8	0	0	0	0	0	0	X	1
C_9	0	0	0	0	0	0	0	0
C_{10}	X	X	X	X	X	X	X	7
Summary and significance								
Frequency Experimental	7	8	6	6	6	7	6	
Frequency Control	4	1	2	4	2	2	3	
Fisher exact p	.11	<.01	.06	.33	.06	<.05	.35	

Note.—See text for discussion of categories.
Mean positive entries: Experimental group, 4.5; Control group, 1.8.
$U = 16.5$, $p < .01$, one-tailed.

used. In one instance the plotting of the data appeared so grossly abnormal that the distribution-free Mann-Whitney U test was used on difference scores. One-tailed statistical probabilities are reported (except for the one statistically insignificant instance of a mean difference in the direction opposite prediction, that is, Word Recognition). Since this report is concerned with a critical appraisal of factors involved in prior findings rather than an initial setting-forth of evidence, the 10% confidence level was selected as an appropriate alpha.

It can be observed that 6 of the 14 criteria achieve statistical significance. Note again that the mean differences of 13 of the 14 criteria are in the direction predicted.

A Mann-Whitney U test was performed on the summation ranks of all the 14 measures as a convenient method for summarizing the overall differences. The one-tailed probability which emerges is $p = .001$, a clear demonstration of expected effects.

Subjects' Reports and the Experimenter's Clinical Impressions

That expected differences exist between the groups is further demonstrated in Table 2, which shows for each subject the number and kind of sensory deprivation "symptom" observed or reported. Following is a brief elaboration of the criteria in the column headings. An analysis of the data reported in Table 2 indicates that experimental subjects exhibited a significantly greater number of sensory deprivation "symptoms" than did control subjects ($p = .01$, one-tailed, Mann-Whitney U test).

Perceptual aberrations. Various reports of unusual perceptions or imaginal activity were obtained, both in subjects' spontaneous remarks and in the interview. Some examples are: "the walls of the room are starting to waver"; "the objects on the desk are becoming animated and moving about"; "the lighting in the room is growing gradually

dimmer and yellower"; "the buzzing of the fluorescent light is growing alternately louder and softer, so that at times it sounds like a jackhammer"; "there are multicolored spots on the wall"; and "the numbers on the number sheets are blurring and assuming various inkblot forms." None of these experiences was especially upsetting to the subjects, nor did they appear in most cases to be more than mildly compelling. An exception is the one experimental subject who terminated by pressing the panic button, and who gave "disorganization of senses" as one of his reasons for ending the experiment.

Intellectual dullness. Generally, this refers to a report by the subject that he experienced marked difficulty in concentration. Typically, those who complained of this said that there was little difficulty at first, but that after about half the period they became unable, even with considerable effort, to think for more than a few seconds on any serious topic. Also included in this category are reports of "blank periods" when the subject could not remember thinking of anything, and which he characterized as being extremely vague and abstract.

Affectively unpleasant. In the interview, subjects were asked to make an overall evaluation of the pleasantness or unpleasantness of the experience. Reports ranged from extremely unpleasant to extremely pleasant. Positive entries in this column indicate a report of mildly unpleasant or worse.

Anxiety or fears. Positive entries in this column denote a report of thoughts of being forgotten, or of being inadvertently left in the room for a long time, or of being trapped while the building burned down. Several subjects reported claustrophobic anxiety.

Spatial disorientation. Included here are reports of the relative dimensions of the room seeming to change, or of the size of the subject in relation to the room seeming to change, or more general comments of confusion or amnesia regarding the location of the room in the building or of the building in the city.

Restlessness. Ratings of restlessness were based on reports by some subjects that they began wondering whether the experiment was worth the money, entertaining semihostile thoughts regarding the experimenter, or having serious impulses to end the experiment. Usually, the reports indicated that such irritability was rather short-lived and not serious, and none of the subjects was overtly hostile to the experimenter upon completion of the experiment.

It will be noted in Table 2 that there are two apparent reversals in each group. An example of these is the final subject in the control group who was in fact quite upset by the experience, and terminated it by knocking on the window 3 minutes before the end of the 4-hour period. Excepting these two reversals, however, the resulting clinical impressions for the two groups were distinct and consistent.

The control group subject typically started his isolation period by inspecting the room, looking through the drawers in the desk, then settling in one of the chairs, and beginning to add the numbers. After this, the pattern of activity would generally consist of long periods of repose interspersed with moderate amounts of activity on the serial additions. These subjects gave the impression, while in the chamber, of being in every way relaxed and in a pleasant frame of mind. The rate of verbalization was lower for control than for experimental subjects; typically there was but a single rather long comment at the beginning telling the experimenter how the subject intended to occupy his time while in the chamber.

In marked contrast to the repose of the controls was the general behavior of the experimental subjects. They usually began the experiment in much the same way as controls: inspection followed by some adding of numbers. But, after the first hour there would ensue a marked restlessness, a decrease in the performance of serial additions, frequent comments of displeasure at some aspect of the experience, or remarks indicating concern over lack of time sense. Occasionally experimental subjects would try to sleep, but with little success. Some exercised, while others undertook an intense and minute inspection of the room. Viewed in relation to the controls, these subjects gave an impression of

almost being tortured. While the control group seemed to alternate between quiet contemplation and work with numbers, experimental subjects seemed to fluctuate between periods of unpleasant restlessness and abstract, vague periods of total inactivity.

DISCUSSION

These findings demonstrate that subjects' behavior can be differentially manipulated by altering the implicit and explicit cues in the experimental situation, and further that subjects may react to social cues, or demand characteristics, in such a way as to confound experimental results.

In the light of our findings, it would seem plausible to suggest that an important confounding variable may be present in much of the reported sensory deprivation research. (Our data yield no evidence, of course, regarding the effect of actual restriction of sensory input. It is possible that many aspects of the reported phenomena in sensory deprivation studies *are* due to the restriction of sensory input.) Our data emphasize the need for further research to determine the actual extent to which the reported "sensory deprivation phenomena" are related to the decrement of sensory input.

In any experiment, the subject's reaction may be viewed as resulting from both the actual treatment (restriction of sensory input by means of gauntlets, goggles, special chambers, etc.) and the social situation created by the setting in which the experiment is conducted, the instructions used, and the cue characteristics of the treatment operations themselves. For example, in our particular experiment the treatment was not that of sensory deprivation, but, rather, of 4-hour isolation. At the same time, the situation (demand characteristics) was deliberately varied for the control and the experimental groups. We interpret our data to mean that four hours of isolation coupled with differing sets of demand characteristics yield different experimental results.

The demonstrated effectiveness of demand characteristics in this or any experiment is not taken to indicate that subjects openly and willfully cooperate with the experimenter. Rather, it is likely that social cues can determine the subject's actual experience in the situation. There is reason to believe that the subjects in the Meaning Deprivation experimental condition actually did experience considerable discomfort. The demand characteristics communicated to the subjects that they would feel discomfort despite any efforts to forestall discomfort. It must be remembered that in order for this communication to be effective, the treatment conditions must be such that they might reasonably be expected to produce just those effects suggested by the pre-experimental cues. This is to say that treatment conditions in themselves communicate crucial social cues and that these are assimilated with the other social cues in the experimental setting to form the demand characteristics of the particular experiment. If both these components of demand characteristics consistently provide an expectation of discomfort and a decrement in performance, then it is likely that the subject's experience as well as his behavior will be constrained by these demands. A distinction is to be made between behavior constrained in this fashion and conscious cooperation (Sarbin, 1950).

The main difficulty in designing definitive sensory deprivation experiments is the inevitable close relationship between the alterations in the physical environment that are necessary to decrease sensory input and the demand characteristics communicated by their use. In order to create the treatment of sensory deprivation, goggles, gauntlets, and various other devices have to be employed. Their use provides obvious cues as to how the subject is expected to behave in the situation.

These considerations suggest that a feasible approach would be to utilize conditions of maximal deprivation while varying the demand characteristics. It is possible to structure the situation so that different groups perceive the restriction as a means to a variety of experimental purposes. It is not possible to eliminate demand characteristics, but they can be varied with relative ease. Cues provided by the deprivation manipulations themselves must remain fairly constant,

but the other cues can be systematically varied, thereby creating a variety of totally distinct sets of demand characteristics for different groups. Such studies would go far toward clarifying the actual effects of reduced sensory input.

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